



Electromobility +



ABattReLife Project

Automotive Battery Recycling and 2nd Life

SUMMARY

Objectives of the project

Value Chain

Challenges

Project organisation and partners

Conclusion

Context and Objectives

Societal : Green mobility

Economic :

- Reduce costs
- Decrease dependancy for raw materials
- Increase EU competitivenss

Environment :

- CO2 reduction
- Better living atmosphere in urban area
- Life cycle impact

Legislative :

- REACH
- ELV and batteries Recycling rates

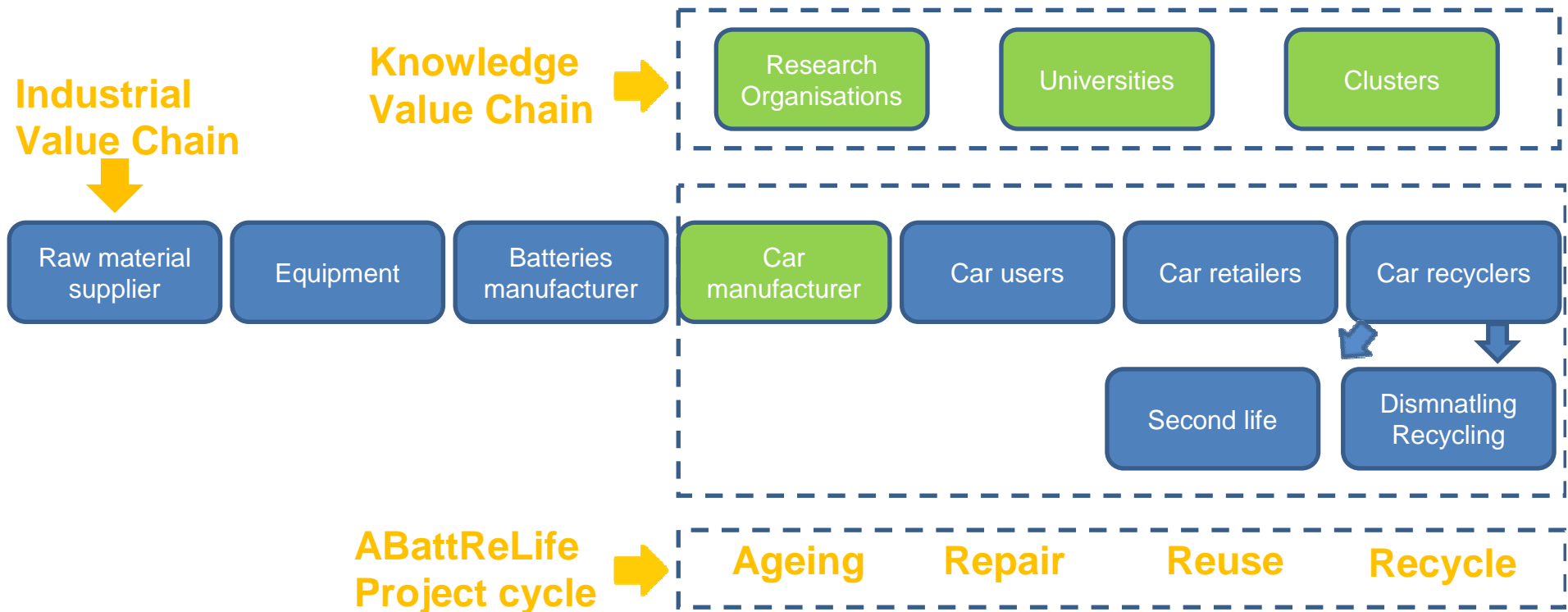
ABattReLife consortium proposes to gather automotive industry players, together with strong academic institutions in order to **assess the technological barriers for a better battery life cycle as well as the most appropriate technologies to ensure a re-use and/or recycling of the batteries at the end of the optimal life cycle.**

Main objectives

→ Focus on Lithium Ion Batteries

- 1 The development and implementation of a knowledge base on high voltage traction battery deterioration
- 2 Safe and economical management structure for EV battery recycling
- 3 Strategies and technologies for battery re-use and recycling

Value chain for batteries life cycle



Challenges

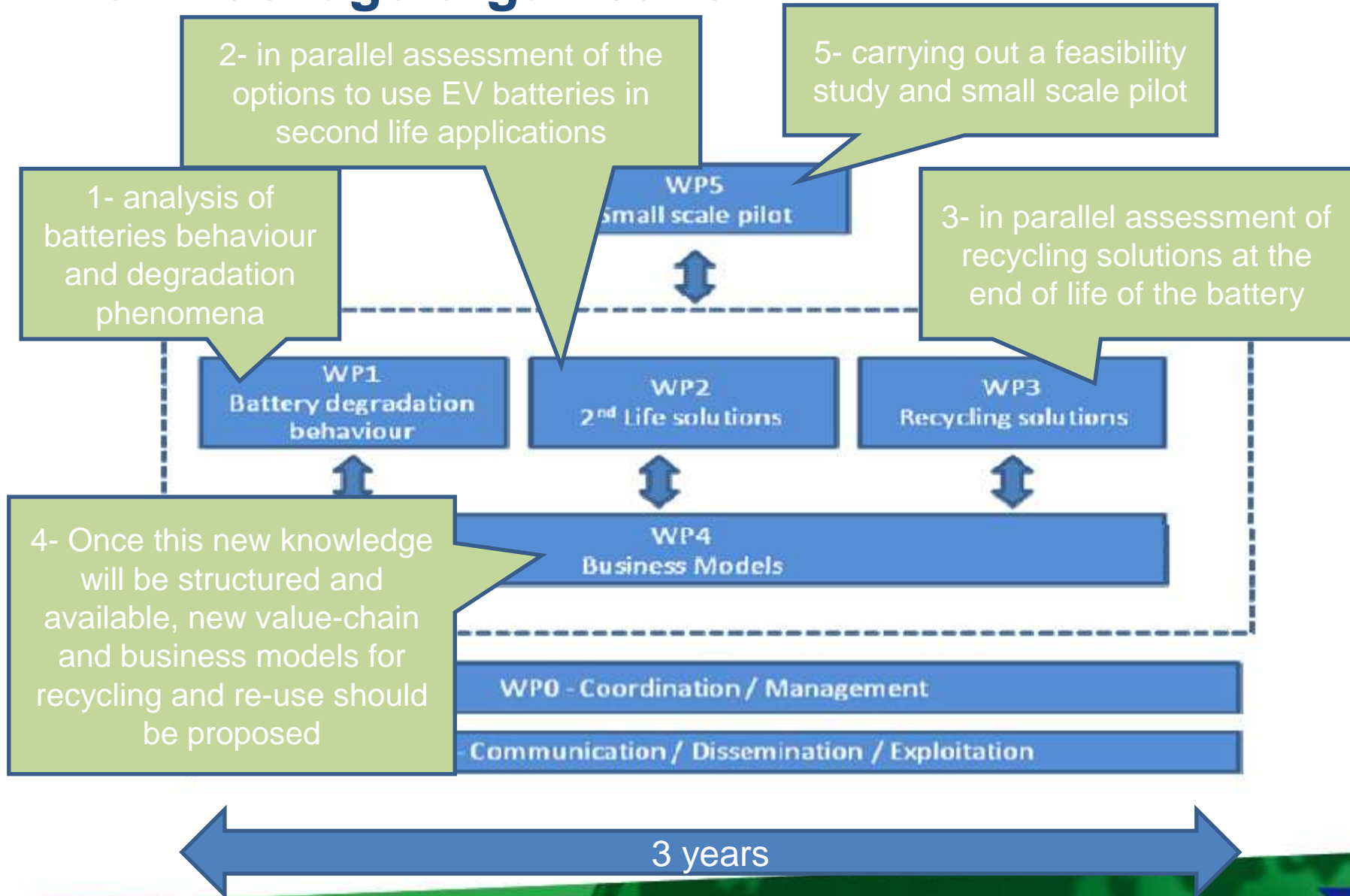
Industrial related challenges:

- ✓ Ensure that battery could be entirely managed from development to end-of-life.
- ✓ Develop the industrial chain covering the whole management of the EV battery (carrying out a “life cycle assessment” from production to recycling and applying the “3 R principle”: reduce, reuse, recycle).
- ✓ Find a new economic model allowing a strong market development and deployment.
- ✓ Costs reduction because of 2nd-use or repair.

R&D related challenges:

- ✓ Develop models reflecting ageing of batteries in relation with charging / discharging stress
- ✓ Gathering experience / real life data about lithium-ion ageing
- ✓ With regard to recycling of materials, develop a new method of reclaiming specific materials from Li-Ion batteries.

WorkPackage organisation



Partners

Applicant organisation name	Short name	Country	Description activity
Peugeot Citroën Automobiles SA	PCA	France	Automotive Constructor
Bayerische Motoren Werke Aktiengesellschaft	BMW	Germany	Automotive Constructor
Nederlandse organisatie voor toegepast natuurwetenschappelijk onderzoek	TNO	The Netherlands	Non profit Research organisation, independant. Research interface between science and market. Experience in new concepts for conventional / hybrid / electric powertrains
KEMA Nederland B.V.	KEMA	The Netherlands	Independant consulting and testing organisation. 3 battery test laboratories for testing the safety and performance of conventional and advanced batteries.
Fraunhofer-Gesellschaft zur Foerderung der angewandten Forschung e.V	FhG-ISC	Germany	Leading organisation for applied research in Germany : 60 institutes with different research areas. Many years of experience in material and component development for batteries and expertise in electrochemistry.
Pôle Véhicule du Futur PVF France	PVF	France	Cluster Vehicle of the future. Work with group companies.
Technische Universität München	TUM-EES	Germany	Part of TU Munich, member of interdisciplinary Science center of Electromobility (WZE) the EES is involved in many activites regarding electric vehicles. Behavior, state determination and modelling of Li-ion accumulators. Long term tests started, data on ageing.
Technische Universität Bergakademie Freiberg	TUBAF	Germany	University with special focus on ressources technology along the entire value chain form exploration in geology to the end of life in mechanical and metallurgical recycling.
Universite De Technologie De Belfort-Montbeliard	UTBM	France	Research lab in humanities and social sciences. The economic analysis of change concerns the carbon free energy sector (smart-grids) and the automotive industry.
Université de Technologie de Troyes	UTT	France	CREIDD : Centre de Recherche Etudes environnementales et Développement Durable.

Conclusion

Relevant and motivated partners for this project :

- Technical and scientific knowledge
- Industrial view

But ...Difficulties to build this project :

- Different national timings (France december 2011, Germany May 2012)
- Modification of the Financial budget at national level
- Different funding rates between countries
- Modification of the job sharing after the acceptation of the project

Official beginning of the Project in May 2012 !



Annex

Partners of the project

Electromobility + ¹¹

					Total initial budget	Total initial funding	Total final budget	Total final funding	% fundi ng
1	Peugeot Citroën Automobiles SA	PCA	F R	Leader	305 786,66 €	60 000 €	304 547,73 €	60 000 €	20%
2	Bayerische Motoren Werke Aktiengesellschaft	BMW	D E	Partner	308 707,65 €	154 353,83 €	111 760 €	44 704 €	40%
3	Nederlandse organisatie voor toegepast natuurwetenschappelijk onderzoek	TNO	N L	Partner	258 863 €	258 863 €	264 071 €	258 863 €	98%
4	KEMA Nederland B.V	KEMA	N L	Partner	263 750 €	263 750 €	251 750 €	251 750 €	100%
5	Fraunhofer Gesellschaft zur Foerderung der angewandten Forschung e.V	FhG-ISC	D E	Partner	226 555,85 €	226 555,85 €	152 975 €	152 975 €	100%
6	Pôle véhicule du futur	PVF	F R	Partner	35 038,50 €	22 775,03 €	31 479,76 €	13 632,97 €	43%
7	Bayern Innovativ GmbH	BI	D E	Subcontractor	35 000 €	35 000 €	0 €	0 €	-
8	Technische Universität München	TUM-EES	D E	Partner	268 309 €	268 309 €	253 992 €	253 992 €	100%
9	Technische Universität Bergakademie Freiberg	TUBAF	D E	Partner	549 845 €	549 845	462 000 €	462 000 €	100%
10	Université de Technologie De Belfort-Montebeliard	UTBM	F R	Partner	165 642,17 €	105 788,80 €	165 342,17 €	97 9888,80 €	59%
11	Université de Technologie de Troyes	UTT	F R	Partner	137 276 €	85 007 €	138 190 €	80 540 €	58%
TOTAL (€)					2 554 773,83 €	2 030 247,50 €	2 118 107,66 €	1 658 445,77 €	

Work packages description

WP 0 : Coordination / Management

Leader : PCA - Partners : All

	Month Year 1												Month Year 2												Month Year 3											
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Timing WPO	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
Projet Coordination	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
Project Reporting																																				
Consortium meeting																																				
Legal and financial issues	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█

Final report

Objectives of the WP

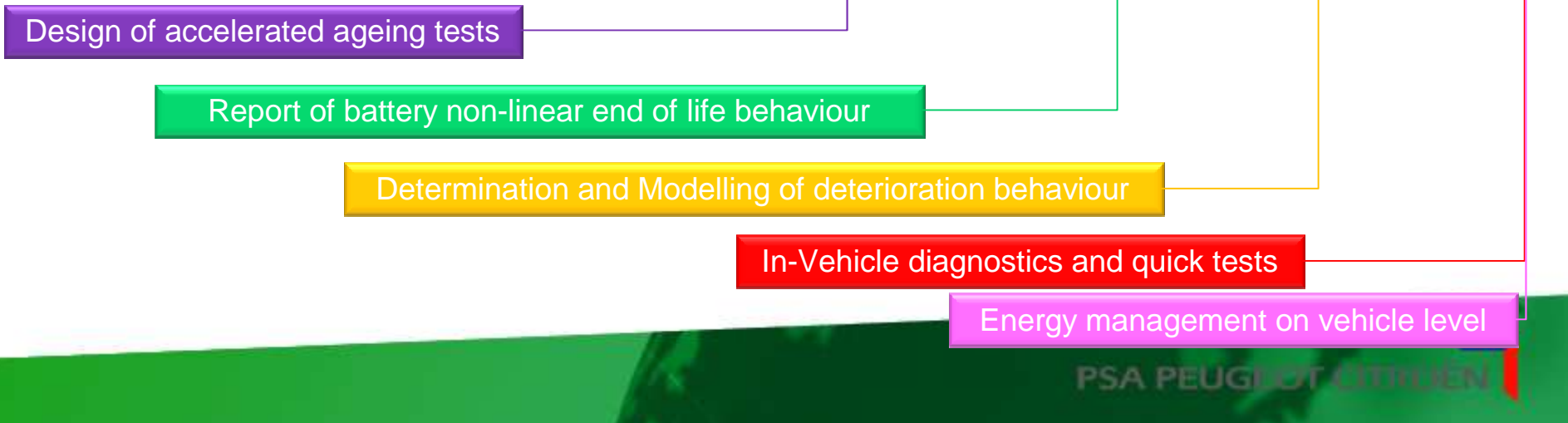
- To ensure a smooth Management of the project and that a good quality work is delivered in due time.

Work packages description

WP 1 : Battery Degradation Behaviour

Leader : TUM-EES & FhG-ISC as co leader - Partners : PCA, BMW, TNO, KEMA,

	Month Year 1												Month Year 2												Month Year 3											
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Timing WP1	[Dark Blue Grid]																																			
Design and execution of accelerated ageing tests	[Dark Blue]												[Light Blue]																							
Investigation & understanding of highly non-linear behaviour at EOL	[Light Blue]					[Dark Blue]												[Light Blue]																		
Mitigation of crucial influences on degradation phenomena	[Light Blue]																		[Dark Blue]						[Light Blue]											
Modelling of battery behaviour including knowledge about deterioration	[Light Blue]																						[Dark Blue]				[Light Blue]									
In-vehicle diagnostics and quick test of battery degradation	[Light Blue]																														[Dark Blue]					
Definition of load profiles and energy management for EV applications	[Dark Blue]																																			



Work packages description

WP 1 : Battery Degradation Behaviour

Objectives of the WP

- Design and execution of accelerated ageing tests
- Intensive Research on highly nonlinear battery behavior at the EoL by electrical engineering AND chemical analyses
- Investigate the influence of change of operation type on battery lifetime in order to diminish the battery deterioration
- Development of methods and models to determine the SoH (in-vehicle and quick test) and to estimate the battery life when operation type is changed
- Develop a classification of failed EV batteries and investigate methods to estimate the ability to repair EV batteries
- Integration of knowledge in all levels (cell, battery pack, EV) to diminish deterioration

Hard spots / Key point

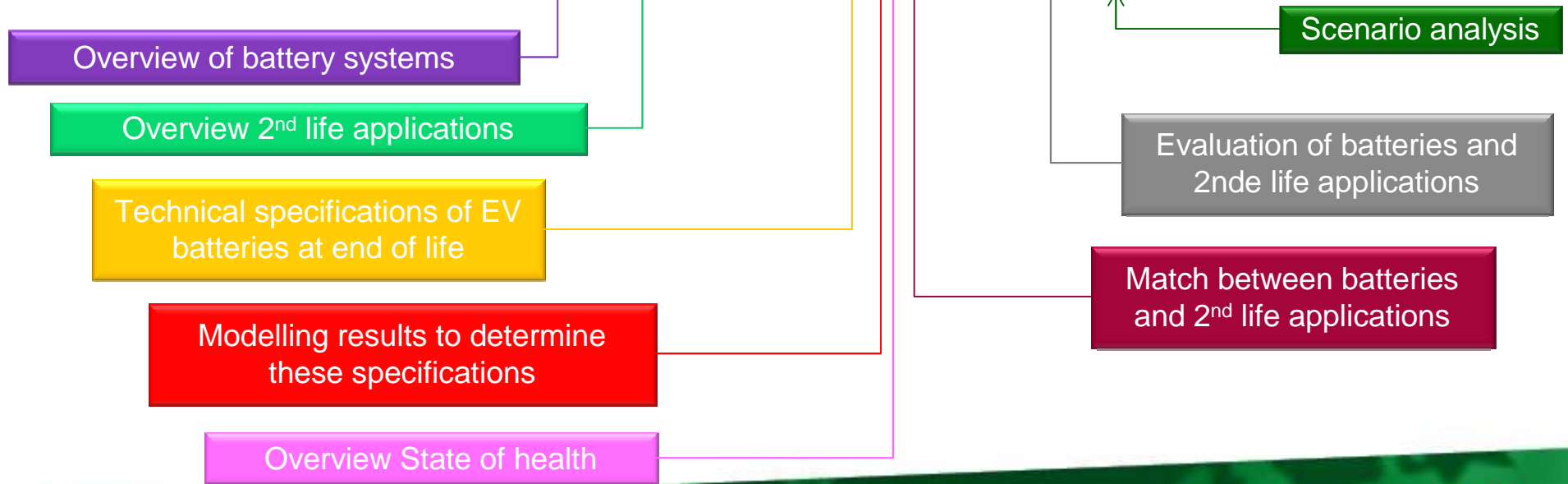
- Define the methodology for accelerates ageing tests : tests on cells, batteries pack ...?
- In order to determine the number of batteries needed to perform the tests.

Work packages description

WP 2 : 2nd Life Solutions

Leader : KEMA - Partners : PCA, BMW, TNO, KEMA, FhG-ISC

	Month Year 1												Month Year 2												Month Year 3											
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Timing WP2	[Dark Blue Grid]																																			
EV Battery systems	[Dark Blue Grid]																																			
2 nd Life battery specifications	[Dark Blue Grid]																																			
Repairing of Batteries	[Dark Blue Grid]																																			
Applications of 2 nd life batteries	[Dark Blue Grid]																																			
Integration	[Dark Blue Grid]																																			
Scenario analysis	[Dark Blue Grid]																																			



Work packages description

WP 2 : 2nde Life Solutions

Objectives of the WP

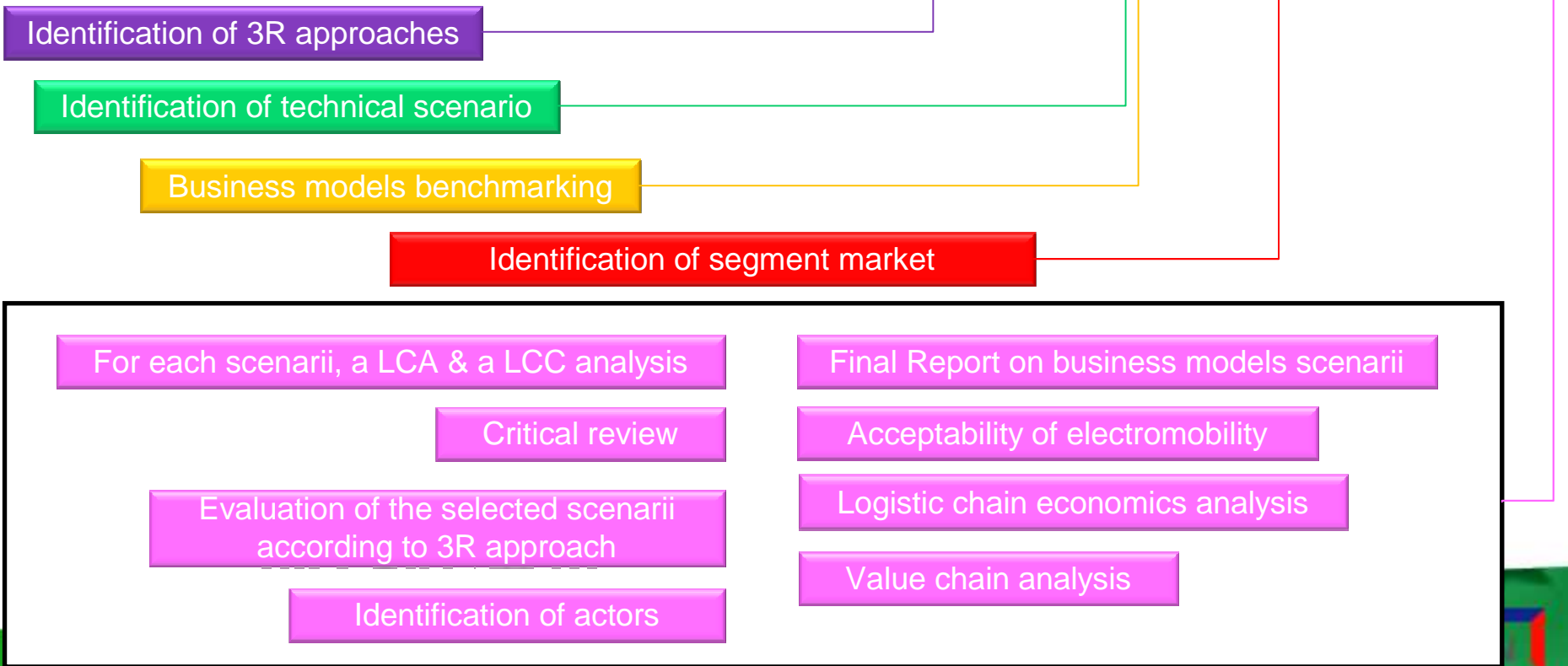
- Model degradation and SoH of EV batteries
- Determine the technical specifications of 2nd life batteries
- Evaluate 2nd life grid connected applications based on a software tool

Work packages description

WP 4 : Business Models for batteries 2nd life and recycling solutions

Leader : PCA - Partners : BMW, KEMA, UTBM, UTT

	Month Year 1												Month Year 2												Month Year 3											
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Timing WP4	[Dark Blue]																																			
Technical scenarios about the recycling and the 2 nd life of batteries	[Dark Blue]																																			
Definition of a business model	[Light Blue]												[Dark Blue]												[Light Blue]											



Work packages description

WP 4 : Business models for batteries 2nd Life and recycling solutions

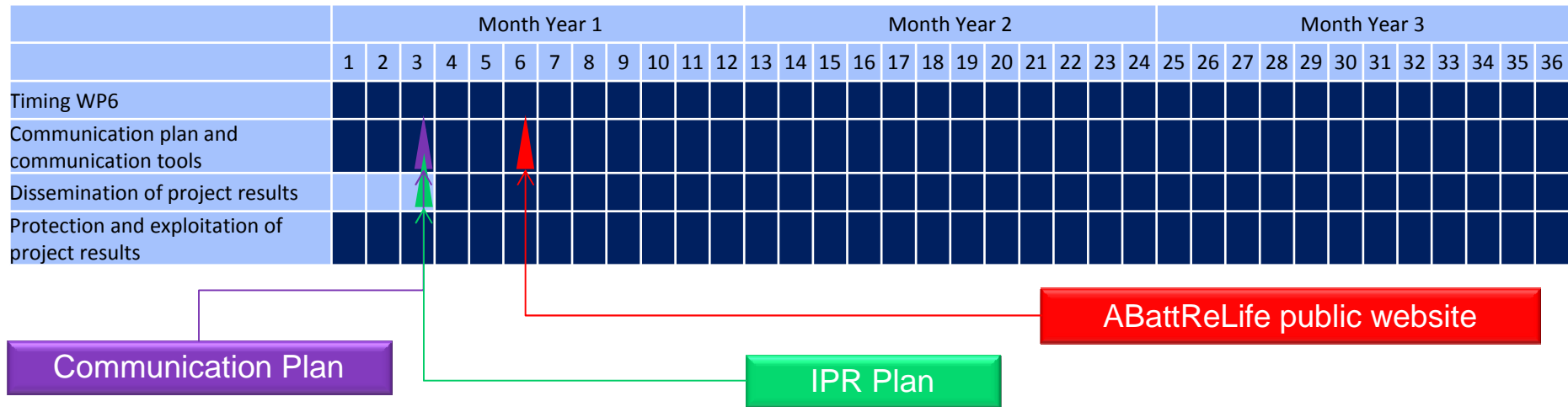
Objectives of the WP

- Which business models to capture value from recycling and 2nd life battery activity?

Work packages description

WP 6 : Communication / Dissemination / Exploitation

Leader : PVF - Partners : All



Objectives of the WP

- The objective of this WP is to optimize the communication strategy and tools by providing a coherent framework and actively pursue dissemination strategy for the results generated.